~~27.~~ 8 The device according to claim ~~18~~ 1 or ~~26~~ 7 wherein said cell wall structure is treated to align the liquid crystal.

~~28.~~ 9 The device according to claim ~~18~~ 1 or ~~26~~ 7 wherein said cell wall structure is treated to homeotropically align said liquid crystal.

A' Cont'd

~~29.~~ 10 The device according to claim ~~26~~ 7 wherein said means for establishing a field through said material is adapted to provide an AC pulse.--

Please cancel claims 1-17 without prejudice or disclaimer to the subject matter thereof.

REMARKS

Favorable reconsideration of this application is respectfully requested in view of the above-amendments and the following remarks. The claims are 1-29, claims 1-17 being canceled without prejudice or disclaimer to the subject matter thereof by this amendment. The undersigned would like to thank the Examiner for the interview of November 29, 1994, during which it is believed the allowability of the claims over the art of record was established to the satisfaction of the Examiner. No new matter is introduced by the foregoing amendment and, to complete the record, the substance of the Office Action and the basis for the allowability of the claims is discussed below.

The Declaration was objected to and a new oath or declaration in compliance with 37 C.F.R. § 1.67(a) was required. Specifically, it was noted that the numbers in Serial No. 07/694,840 were transposed, and that the instant application claims priority of application Serial No. 07/885,154, but failed to include it in the declaration. Submitted herewith is a substitute declaration correcting the inaccuracies of the continuing information. Accordingly, the objection to the declaration is believed to be moot.

The drawings were objected to because of reference made in the specification to an item 50 in Figure 3, which does not include such a reference numeral. The specification has been amended to correctly reference item 30 in Figure 3. Since this was an obvious error, which has now been corrected, this



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objection is believed to be moot. The specification has also been amended to correct several obvious errors in the references to the drawing figures.

Claim 11 was rejected under 35 USC § 112, second paragraph, as lacking antecedent basis for the A.C. pulses. Claim 11 has been canceled. Accordingly, this rejection is believed to be moot and it is further believed that no analogous deficiency exists in the newly submitted claims.

The specification was objected to and claims 1-17 were rejected under 35 U.S.C. § 112, first paragraph, as being non-enabled in view of the teachings of Tsukamoto. As discussed in the interview, and as set forth below, this rejection was based on a misinterpretation of the reference and is believed to be moot in view of the newly submitted claims.

The rejection was grounded in the premise that Tsukamoto disclosed the same material as claimed but exhibited different properties. In particular, applicant's claims recite two optical states that are stable in the absence of a field, but Tsukamoto requires a bias voltage to maintain at least one of his states. Thus, it was surmised that applicant did not disclose how to make and use a material as claimed. The confusion rests in the optical states being employed in the device of Tsukamoto as compared with the optical states being employed in the applicant's invention. Rather than switching between focal conic and twisted planar states as claimed, Tsukamoto switches between a transparent homeotropic state and a focal conic state.

As is known in the art, the homeotropic state of a cholesteric liquid crystal is not stable in the absence of a field. Accordingly, this state of Tsukamoto degenerates unless a bias voltage is used. However, applicant's invention does not employ the homeotropic state as disclosed in Tsukamoto, but instead switches between planar and focal conic textures, both of which are stable in the absence of a field. Therefore, applicant's cell does not need the bias voltage associated with Tsukamoto's transparent homeotropic state. Since the two devices switch between different liquid crystal states, the disclosure of Tsukamoto is not inconsistent with applicant's device. In further support thereof, applicant's device was demonstrated in the interview to switch between states, and after so switching, the voltage source was completely disconnected from the device without any decay



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of either optical state. Based on the distinctions between applicant's cell and Tsukamoto's, it is clear that nothing in Tsukamoto suggests that applicant's disclosure is in any way deficient or non-enabling, only that it is different. Accordingly, it is respectfully submitted that the rejection should be withdrawn.

Claims 1, 6-15 and 17 were rejected under 35 USC § 102(b) as being anticipated by Tsukamoto et al. As discussed in the interview and as set forth below, Tsukamoto does not teach or suggest the applicant's invention. The distinctions between the two have been amplified in the newly submitted claims, and it is respectfully submitted that the claims are now clearly patentable over the art of record.

Claim 18 features a light modulating reflective cell comprising cell wall structure and a chiral nematic liquid crystal light modulating material having positive dielectric anisotropy and a pitch length effective to reflect light in the visible spectrum. The liquid crystal forms focal conic and twisted planar textures that are stable in the absence of a field. The cell of claim 1 features means for addressing the liquid crystal material adapted to selectively establish an electric field pulse of a magnitude effective to transform at least a portion of said liquid crystal from a focal conic texture to a light reflecting twisted planar texture, and an electric field pulse of a magnitude effective to transform at least a portion of said liquid crystal from a light reflecting twisted planar texture to a focal conic texture.

Tsukamoto does not teach or suggest a reflective cell as claimed, or a device that employs both focal conic and twisted planar textures that are stable in the absence of a field as claimed. There is no teaching or suggestion in Tsukamoto of switching between focal conic and twisted planar textures by application of an electric field pulse as claimed or to include a means for doing so. Nothing in Tsukamoto can even be cited as suggesting that such a device would be possible. Instead, Tsukamoto employs homeotropically aligned transmitting state that requires a bias voltage. Nothing therein teaches or suggests that one could switch between stable focal conic and twisted planar textures, or to do so with means for providing an electric field pulse. Likewise, there is no

suggestion in Tsukamoto that such states would be stable in the absence of a field without a bias voltage.

More specifically, the nature and function of the device of Tsukamoto and that of the claimed invention are fundamentally different. Whereas Tsukamoto switches between a transmitting state in which the liquid crystal is homeotropically aligned, and a scattering state in which the liquid crystal is in the focal conic texture, the claimed invention switches between a visible light reflecting state and a weakly scattering focal conic state. Whereas at least one optical state of Tsukamoto requires a bias voltage, both optical states of the claimed invention are stable in the absence of a field. Whereas the device of Tsukamoto requires a drive means adapted to establish and maintain a homeotropically aligning field and a bias voltage, the claimed invention requires a means adapted to switch between the optical states with an electric field pulse, the magnitude of which controls the optical state of the cell. Tsukamoto is devoid of the teachings necessary to employ the optical states of the claimed invention in a useful manner or to drive them in the manner claimed. Accordingly, claim 18 is novel and unobvious in view of Tsukamoto. Since claim 18 is patentable over Tsukamoto, so are claims 19-21 which depend therefrom.

Independent claim 22 features a method of addressing a visible reflecting cell comprising selectively applying voltage pulses of a magnitude effective to transform at least a portion of said liquid crystal from a focal conic texture to a light reflecting twisted planar texture, or to transform at least a portion of said liquid crystal from a light reflecting twisted planar texture to a focal conic. As discussed above, and at the interview, nothing in Tsukamoto teaches or suggests a method as claimed. Tsukamoto does not switch between the optical states employed in applicant's method. Nothing about the optical states and bias voltages of Tsukamoto suggests that one could employ the optical states as claimed, nor that they could be addressed by an electric field pulse as claimed. Nothing in the disclosure of Tsukamoto suggests that the claimed optical states would be stable in the absence of a field and not require a bias voltage. In short, the methods associated with Tsukamoto are entirely different and unrelated to the claimed method and there is no teaching or suggestion in the reference that could

have motivated one of ordinary skill in the art to arrive at the claimed invention, or how to do so, absent the teachings of applicant's disclosure. Accordingly, claim 22 is patentable over Tsukamoto. Since independent claim 22 is patentable over Tsukamoto, so are claims 23 and 24 which depend therefrom.

Independent claim 25 features a method of selectively adjusting the intensity of reflection of colored light from a chiral nematic liquid crystalline light modulating material having positive dielectric anisotropy and a pitch length effective to reflect light in the visible spectrum, between a maximum and a minimum intensity. The method comprises subjecting said material to an electric field pulse of sufficient duration and voltage to cause a first proportion of said chiral nematic material to exhibit a twisted planar texture in the absence of a field and a second proportion of said chiral nematic material to exhibit a focal conic texture in the absence of a field, whereby said material will continuously reflect a selected intensity between said maximum and minimum that is proportional to the amount of said material in said focal conic and twisted planar textures in the absence of a field. Since Tsukamoto does not even teach or suggest a method employing both twisted planar and focal conic optical states, or how to switch between them, it clearly does not teach or suggest the method as recited in claim 25, wherein by varying the magnitude of the electric field pulse, one can obtain mixtures of the two optical states, the resulting optical states being stable in the absence of a field and not requiring a bias voltage. Accordingly, claim 25 is patentable over Tsukamoto.

Since claim 25 is patentable over Tsukamoto, so is claim 26 directed to the material exhibiting both the stable twisted planar and stable focal conic texture in the absence of a field. There is no teaching or suggestion in Tsukamoto of both states, let alone the simultaneous application of both of them. More importantly, there is nothing in Tsukamoto that teaches or suggests how one of ordinary skill in the art could obtain a mixture of such states. Tsukamoto also fails to teach or suggest the claimed means adapted to provide an electric field pulse of sufficient voltage and duration to change the proportion of said material in said twisted planar and focal conic textures. Accordingly, claim 26 is patentable over

Tsukamoto. Since claim 26 is patentable over Tsukamoto, so are claims 27-29 which depend therefrom.

Claims 2, 3 and 16 were rejected under 35 USC § 103 as being obvious in view of Tsukamoto, and claims 4 and 5 were rejected as being obvious over Tsukamoto in view of Iwasaki. Since these claims have been canceled, the rejection is moot. Moreover, for the reasons set forth above it is clear that Tsukamoto does not teach or suggest the claimed invention and, as discussed in the interview, Iwasaki does not cure the deficiencies of Tsukamoto. Iwasaki merely discloses a variation of a transmission type display as disclosed in Tsukamoto employing a highly positive dielectric anisotropy material. Nothing in Iwasaki teaches or suggests the claimed invention or how one might modify Tsukamoto to obtain it. Accordingly, it is respectfully submitted that the claims are allowable over the art of record.

U.S. Patent No. 4,097,127 to Haas, which was submitted in a supplemental information disclosure statement, was also discussed and distinguished from the instant claims in the interview for the reasons below.

First, Haas does not disclose a cell in which the liquid crystal has a pitch length effective to reflect light in the visible spectrum as required by the claim. The liquid crystal material of Haas has a pitch length in the infra red. In support of this there is attached a Declaration of John L. West under 37 CFR § 1.132 establishing that the material of Haas in fact reflects outside the visible spectrum. As discussed in the interview, and as set forth in the Declaration, the material of Haas was prepared and observed not to reflect light in the visible spectrum. The cell according to Haas was demonstrated to the Examiner during the interview not to exhibit reflection in the visible region. The direct measurement of the pitch length of the liquid crystal mixture according to Haas is set forth in the accompanying Declaration as being 14 microns, which will not reflect in the visible spectrum. As a result, the material of Haas behaves differently and exhibits a different electro-optic effect. The materials of Haas are transparent or clear in the Grandjean texture and employ the light scattering focal conic texture to create images, such as the letter X disclosed therein. By contrast, the claimed material is not transparent in the twisted planar texture, but instead reflects colored light,

and the focal conic texture is only weakly scattering such that it is used to effectuate a clear state.

Second, Haas does not disclose a cell including means for addressing the liquid crystal adapted to selectively establish an electric field pulse of a magnitude effective to transform the liquid crystal from the focal conic to the twisted planar texture, and an electric field pulse of a magnitude effective to transform the liquid crystal from the twisted planar to the focal conic texture. In column 2 of Haas, beginning at line 55, he states that his invention lies in the discovery that a liquid crystal material transformed by an applied field into the nematic phase from either the focal conic or twisted planar (Grandjean) texture can be transformed into a mixture of the two by decreasing the amplitude of the applied electric field over a period of time effective to form the mixture. In column 3 he reports that suitable times over which the magnitude of the voltage is reduced range of from about 10 to 200 milliseconds. Thus, Haas discloses a system in which he obtains his various optical states by always aligning the liquid crystal into the nematic phase and then slowly decreasing the amplitude of his applied voltage over a period of time until he reaches the desired state.

By contrast, in the claimed cell the final optical state of the liquid crystal is controlled by the magnitude of an electric field pulse, not by time, and it is not necessary to align the liquid crystal into the nematic phase every time it is desired to change optical states. The claimed invention switches the material to the twisted planar texture with an electric field pulse of a set magnitude, to the focal conic texture with an electric field pulse of a set magnitude, and to a grey scale mixture of focal conic and twisted planar textures with electric field pulses of a set magnitudes. The various electro-optical states of the claimed invention are not obtained by increasing or decreasing the magnitude of an applied voltage over a sustained period of time. Instead, the magnitude of the electric field pulse of the claimed invention remains essentially constant during the pulse and it is the magnitude of the pulse that determines the optical state of the cell. Accordingly, nothing in Haas teaches or suggests a cell or method of addressing as claimed.

Moreover, it would not have been obvious that one could adapt Haas' material for use in a cell as claimed, nor would one of ordinary skill in the art

have been motivated to do so absent the teachings of Applicant's disclosure. Nothing in Haas teaches or suggests that one could transform the material from the Grandjean to the focal conic texture, or that one could obtain a mixture of focal conic and Grandjean textures without first driving the material to the nematic phase and then slowly decreasing the magnitude of the applied voltage. Nothing therein suggests that a useful display could be obtained by adjusting the pitch length to reflect in the visible spectrum, nor is there any disclosure therein that could have motivated one of ordinary skill in the art to try. One could not expect that the material would be switchable or that the states to be obtained would be stable. One of ordinary skill in the art would not expect that one could control the intensity of the reflective state without altering the color, that one could use the focal conic state as a clear state without affecting the appearance of the reflective state, or that by modifying the material to reflect in the visible spectrum, one could still maintain stable focal conic and twisted planar states and still be able to switch the cell in a useful manner.

Even if one did modify the material of Haas to have a pitch length effective to reflect light in the visible spectrum as claimed, there is still no teaching therein of how one should address such a material, let alone to include an addressing means as claimed. There is nothing in Haas that could have motivated one to arrive at the claimed invention. Accordingly, the claimed invention is novel and unobvious over Haas or any combination of Haas with the references of record.

No combination of Haas with any of the other references of record teaches or suggests the claimed invention. As has been established, Haas obtains his optical states by slowly reducing the magnitude of his applied voltage over a sustained period of time from the nematic phase. Tsukamoto switches between a transparent homeotropic state which requires a bias voltage. First, since the manner of operation and optical states employed by the two devices are entirely different, one of ordinary skill in the art would not have been motivated to combine them. Second, even if they did, no combination thereof teaches or suggests a visible reflective cell switching between stable focal conic and twisted planar textures with means for establishing electric field pulses, wherein the

magnitude of the pulse controls the optical state of the cell. Accordingly, the claimed invention is patentable over any combination thereof. None of the other references of record alter this conclusion.

Finally, there is also attached a Declaration of Dr. J. William Doane, Director of the Liquid Crystal Institute, attesting to the significant contribution the claimed invention will make to the industry. As discussed therein, the claimed invention overcomes the numerous shortcomings of existing technology which have prevented to production of low cost, light weight, reflective displays. As a result, the industry will for the first time be able to manufacture print-on-paper quality reflective displays that are inexpensive, light weight and durable. Importantly, as a result of the applicant's discovery that the claimed device can be switched between stable optical states with the application of electric field pulses, the magnitude of which controls the optical state, displays can be prepared according to the invention that can be addressed at commercially acceptable speeds. Accordingly, the claimed invention is a significant advance in the art.

Since the claims have been shown to be allowable, a favorable response in the form of a Notice of Allowance is earnestly solicited. However, if the Examiner considers there to be any remaining issues, it is respectfully requested that the Examiner contact the undersigned at the number below in an effort to resolve any such issues by phone.

Respectfully submitted,

Dated: 12/22, 1994

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